Evaluating the Closure of Riverside Drive – a discussion paper.

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Introduction

Good planning needs informed discussion of alternatives at all stages – one can't make decisions in a vacuum, and by the time conclusions are reached it is often too late to point out fundamental problems with the studies underlying those conclusions.

We all know this and the City Council has attempted to structure decision processes so as to build upon a consensus of assumptions and modeling methodology, with public input at all stages.

Unfortunately project time-scales and communication problems may make this difficult to achieve in practice. So it is that in April 2002 we find ourselves faced with staff policy recommending that Riverside be retained as a meandering two lane road through the Town Lake park. Citizens have been shown first a recommendation, then only after enquiry a draft of the report on which those conclusions were supposed to have been based. On examination we then find that the summary report contains some most implausible figures, which can only be attributed to failures in the modeling process.

The Modeling Process

The study of Riverside closure is part of the "Downtown Access and Mobility Study" being conducted by Wilbur Smith Associates. This study uses the Federal Highway Administration's CORSIM software to evaluate various changes in the downtown road network. To understand the problems it is necessary to understand the purposes of and limitations of this software: when used properly it is a very valuable tool for the traffic engineer but it was designed for specific purposes only and is limited by the assumptions built into its design.

CORSIM simulates the delays that occur at junctions. For each junction it models the pattern of cars arriving, given the volume of traffic on each approach road and the percentages of vehicles turning. It estimates delays and can be used to show the effects of changing the percentage of green time given to each street, or of adding a right turn lane.

It is also a relatively old model and has been overtaken by some newer competitors in this field. Compared to these competitors it exhibits weaknesses in modeling certain very congested situations. In particular great care is needed where intersections are linked or where traffic backs up across intersections. The FHA have announced that they will be dropping support for this program.

The basic data used in the study was obtained from April 2000 counts of traffic at each major intersection in the study area. There are no data of where drivers are coming from or where they are trying to get to, simply counts of traffic showing the number travelling straight through, turning left and turning right.

Where Will They Go?

It should be obvious that when you are studying the closure of a road, the most important question to ask is which routes diverted traffic will take. Surprisingly the model has no answer on this question: it was just based on junction counts and has no idea where these cars were coming from or where they are attempting to get to. Without that information it can't possibly make any informed judgement as to which route the drivers will choose. We learn that the City has, from previous studies, collected information on the origins and destinations of drivers using Riverside. Nothing similar was obtained for other movements and for the purposes of this study no use was made of that information.

Instead the modelers have arbitrarily assumed that 40% of Riverside traffic will continue to use Lamar bridge, 40% South 1st and 20% Congress bridge. We were told that these numbers were chosen because they roughly correspond to the existing volume of traffic on each bridge. Since left to themselves existing drivers choose these bridges in those ratios, it was assumed that the diverted drivers would adopt those bridges in similar proportions.

Unfortunately this is not a very convincing argument: here we are only talking about drivers who have ALL chosen to use Lamar bridge at present. It might be reasonable to argue that of the drivers who choose to divert from Lamar, the 2 to 1 ratio in favor of South 1st bridge over Congress bridge should apply but there is no rational basis to assume that 60% of drivers who had previously chosen Lamar now will use other bridges.

Drivers are going to choose the route which they perceive as minimizing their travel times. To estimate this we need some idea of where they are coming from and trying to get to. Without Origin-Destination information it becomes very difficult to estimate how traffic will change in response to changes in the network. For example would drivers coming from SE Austin choose to use the I35 bridge instead? How many drivers on Lamar at present come from areas (such as the Bouldin Creek neighborhoods, or communities beyond Ben White) which could just as easily use South First Street?

While small modifications in junctions, such as the other recommendations in this study, produce relatively limited effects which can be adjusted for by simple adjustments to traffic counts, closing Riverside Drive requires an explicit prediction of which routes traffic will switch to.

The Real World

We are dealing with a congested situation. Each morning and evening thousands of drivers trying to reach their work, school or other destinations have to cross the river using one of a limited number of bridges. Some will only have one realistic choice of route but for many (probably most) of these drivers there are several possible choices of route, and each will choose the bridge they believe minimizes their travel time.

To take an example, I often have to travel from my office on South Lamar to a client at 6th and Congress. I could take Lamar to 5th Street, or Lamar to Barton Springs then Barton Springs Road all the way to Congress Avenue, or perhaps a combination using South First Street bridge. If I want to avoid congestion on Barton Springs Road, I have the option of using Oltorf to Congress. While at present I usually take Barton Springs Road to Congress, I have plenty of choices should conditions change.

In fact almost every single driver using South First Street, has a choice of several almost equally good alternatives. Those coming from close in neighborhoods will either lie between Lamar and S First or between S First and Congress. More importantly for all the drivers South of Oltorf, there are plenty of routes that can take them across any of the three central bridges. If conditions on any one bridge change, they can use another bridge.

Our present traffic patterns are the result of many thousands of these individual decisions. It has been said that congestion, like water, finds its own level. The upshot of the many individual decisions is that the traffic volume over each bridge will adjust itself to a level where congestion by these different routes is about the same.

When the highway engineer makes changes which reduce congestion on one bridge, and increase it on another, it is a sure bet that drivers not directly affected by the change will adjust their travel patterns to take advantage of the less congested alternative. Each driver continues to choose his least travel time route and if travel time by a particular bridge changes there will be some drivers who will find it worth their while changing their route. Given the multiple options open to most drivers, demand on individual bridges is going to be "highly elastic": a small change in cost (time) results in a fairly large change in volume. Of course total demand is fairly inelastic – everyone has to get to work – and in many situations (e.g. traffic on Mopac or I35 bridges) drivers will have few choices. But in South Austin, with three bridges fairly close together, drivers have a choice.

So changes in volume using each bridge will quickly bring congestion back to a level where the time difference between bridges remains about the same as before the change. The end result will be that average travel times across each bridge continue to be about equal to each other: a change may increase congestion on all bridges but it is not going to result in vastly reduced travel time on one bridge and a vast increase on another.

Any model that does not take this into account is going to underestimate the value of road improvements and more importantly (because of the nonlinear effects of congestion) greatly overestimate the cost of capacity reductions.

The Problem

The problem with the present analysis is that the present model does not do this. CORSIM uses changes in traffic figures fed it by an engineer to predict the congestion that will occur. It can show you that if you add another 500 vehicles an hour to an already congested route severe delays would occur, which would add several minutes to travel time. This may be accurate – if volume really increased to that level. CORSIM does not tell you how many drivers would still choose that route. In practice you can bet that if travel time on one route increased by so much, a fair proportion of drivers would find a new route to work. The model does not reflect this.

The problem is exacerbated because the engineers only coded up one particular route for the traffic diverted to each bridge. All traffic assumed to divert via either Congress or South 1st bridge (60% of the total Riverside traffic) was assumed to turn left onto 2nd Street and then left on San Antonio to join Cezar Chavez. In practice drivers could use other downtown routes. For traffic still using Lamar, Lee Barton could help relieve congestion at the junction of Barton Springs Road and Lamar but no Riverside diverted traffic was assumed to use it.

To give a particular example where junction delays are totally unrealistic, most of you will be familiar with the "X" where Barton Springs Road and Riverside Drive cross over (by Threadgill's World Headquarters). Westbound traffic wanting to take Barton Springs Road has to turn left here and there is often a tailback of traffic waiting to make that left turn. Observe this junction and you will notice that many drivers, rather than join that long line, will continue straight through, turn left at South First Street, then turning right on Barton Springs Road. It is slightly further but has the added advantage of avoiding the congested light as Barton Springs traffic waits to cross South First Street.

The point to note is that the combined delay at that left turn from Riverside to Barton Springs plus the delay on westbound Barton Springs waiting for the South First Street light, is never going to much exceed the time taken for this alternative: should congestion increase drivers will simply take the alternative. Unfortunately the CORSIM model does not adjust for this: in studying the closure of Riverside the modelers assumed that an extra 480 vehicles an hour would take that already overloaded left turn from westbound Riverside to Barton Springs Road, and then add to the already congested junction of Barton Springs at South First. Since the maximum numbers of vehicles were already turning left at this junction, every extra vehicle simply adds to a longer and longer queue. The model's estimates of the increased delays resulting from closure of Riverside include unrealistic delays at these junctions.

Making the Right Comparisons

In their recommended solution City staff have proposed a plan which incorporates many minor modifications that together make a significant improvement in traffic flow. Examples of these improvements are the reintroduction of a reversible flow lane on S 1st Street bridge, a better exit from northbound Lamar bridge to westbound Cezar Chavez, improvements at the Lamar/Barton Springs junction, and left turn restrictions to improve traffic flow on Congress Avenue and on Lamar at 5th/6th streets. These changes were all needed to reduce observed congestion on these routes.

However in examining the closure of Riverside Drive, the study did not compare it to this recommended option. Instead they imposed the effects of closing Riverside on a base case which did not include these modifications. In that base case South 1st bridge was severely congested while Congress traffic was bogged down by left turns, causing back ups over the bridge. So when you close Riverside Drive where is the traffic going to divert to? Similarly without improvements on Lamar, particularly at the Barton Springs intersection, severe tailbacks at that junction are inevitable, which as it turns out severely affect traffic diverted from Riverside onto Barton Springs Road.

Finally, no one in their right mind would suggest closing Riverside without making some modifications to assist diverted traffic. Staff reported that problems arose when westbound traffic backed up from the Lamar intersection under the railroad bridge. A simple and obvious solution would be to remark the median lane for use by westbound traffic. If this were insufficient, perhaps an additional right turn lane will be needed at that point. Note that current staff recommendations call for spending $2.2 million to rebuild Riverside Drive as a new "meandering 2 lane road". Wouldn't it be much less expensive to modify just the bottlenecks on alternative routes?

The Way Forward

It is clear that the present modeling of this proposal is seriously flawed, so much so as to render its forecast totally worthless. However the basic model itself is sound, provided that its limitations are taken into account and adjusted for. Here is how they can be corrected.

1. Start from an optimized network, incorporating the recommended improvements;
2. Make use of the limited Origin-Destination data available from previous studies to allocate diverted traffic across the various routes according to predicted travel time on each route. Fortunately past studies have revealed that the vast majority of drivers using Riverside Drive are coming from SE Austin, either from I35 or East Riverside and are trying to get on to northbound Mopac. It should be relatively simple to extract the

travel times for each practical route then the proportion choosing each route would need to be calculated as a function of the time difference.

3. There will still be considerable uncertainty about the proportion that will choose to remain on Lamar, so spell out clearly that this is just an assumption and perform sensitivity analysis on the effect of higher or lower proportions.
4. Adjust the routes of other traffic to reflect changes in relative delays on each bridge. For example reduced flows across Lamar bridge would allow more traffic from the SW (eastbound on Barton Springs Road or northbound on Lamar) to use Lamar bridge instead of crossing further east. The numbers diverting should be such as to maintain equal travel times for alternative routes using either bridge. In practice this would have to be done by simple factoring of trip counts, resulting in an iterative process of adjusting travel times until the original relative times were restored.
5. Analyze new congestion sites and introduce minor modifications (e.g. additional right turn lane, longer left turn bay, adjust light timings) to mitigate worst congestion.
6. Report where congestion occurs due to closure, what steps can be done to mitigate it and their cost.
7. Recognize the limitations of the model. Sometimes the only way to know what will happen is to conduct a trial.

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17th April 2002